

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

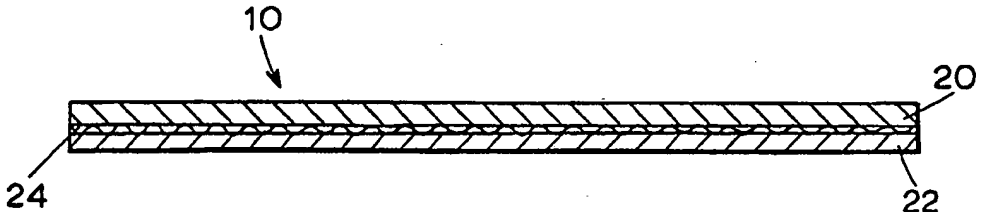
- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problems Mailbox.**

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : B32B 15/12, 29/06, E04C 2/26	A1	(11) International Publication Number: WO 00/48831 (43) International Publication Date: 24 August 2000 (24.08.00)
(21) International Application Number: PCT/US99/03681 (22) International Filing Date: 19 February 1999 (19.02.99) (71) Applicant: INTERNATIONAL PAPER COMPANY [US/US]; 2 Manhattanville Road, Purchase, NY 10577 (US). (72) Inventor: DION, Andrew, N.; 692 Summer Drive, Beaufort, SC 29906 (US). (74) Agent: BRANDON, Richard, A.; Marshall, O'Toole, Gerstein, Murray & Borun, 6300 Sears Tower, 233 South Wacker Drive, Chicago, IL 60606 (US).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: STRUCTURAL LAMINATE AND METHOD OF MAKING THE SAME  (57) Abstract A structural laminate and method of making the same are disclosed. The laminate comprises a thermosetting resin-impregnated paper prepreg layer disposed between first and second metal skins consolidated under heat and pressure. Preferably, the metal skins each have a thickness of at least about 5 mils, and more preferably about 7.5 mils. The prepreg layer is prepared by impregnating paper with a resin, preferably an epoxy resin. The resin is applied such that the resin is present in the prepreg layer in an effective amount of less than about 40 wt. %, preferably about 35 wt. %, based on the total weight of the prepreg layer.		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

STRUCTURAL LAMINATE AND METHOD OF MAKING THE SAME

BACKGROUND OF THE INVENTION

Field of the Invention

5 The invention relates generally to a structural laminate and a method of making the same and, more particularly, the invention relates to a metal-paper-metal structural laminate useful in vehicular trailer bodies and the like.

Brief Description of Related Technology

10 Currently, aluminum sheeting is used in the vehicular trailer market to form structural laminates. For example, a structural laminate is described in International Publication No. WO 98/35114 dated August 13, 1998 (hereinafter the “114 publication”), the entire disclosure of which is incorporated herein by reference. The ‘114 publication teaches that a structural
15 panel can be prepared by laminating skins of sheet metal to a paper core. The metal skins having a thickness of 5 mils to 12 mils are thicker than metal foils. (1 mil equals a unit of length equal to 0.001 inch.) To increase the stiffness of the composite sheet without increasing the thickness of the metal sheet, the ‘114 publication suggests laminating successive sheets of low-cost kraft paper
20 between layers of adhesive and exposed sheets of metal, such as aluminum, thereby increasing the moment of inertia and stiffness of the composite sheet.

According to the '114 publication, one laminate includes sequential layers of a first outer skin of sheet steel, a first adhesive layer, a kraft paperboard core, a second adhesive layer, and a second outer skin of sheet steel. The kraft paperboard core is perforated and has a matrix of circular openings punched from the paper. The openings define paths for adhesively bridging the outer metal skins to each other, where the adhesive bridges form columns of adhesive material oriented transversely to the adhesive layers and integrally connected to the adhesive layers. Without the bridging, the integrity of the laminate is susceptible to failure, in particular from a defect known as buckling, where the fibers in the paper core become separated and there is a local delamination of the paper.

The '114 publication further teaches the importance of the orientation of the paper in the laminates. Specifically, the laminates exhibit better performance (i.e., better stiffness and strength) characteristics when the machine direction of the kraft paper is aligned parallel to a neutral axis of bending than when the machine direction of the kraft paper is perpendicular to a neutral axis of bending.

Alternatively, the '114 publication discloses optionally impregnating a kraft paperboard core with a phenolic resin to improve performance. When the core is impregnated with the resin, the resin content of the core is in a range of 40 wt.% to 50 wt.%.

The present invention relates to an outdoor application wherein the product is riveted in place; hence, there are numerous sites for undesirable water penetration which can lead to corrosion and delamination. Therefore, it would be desirable to provide a structural laminate which, when exposed to various environmental conditions, does not corrode or delaminate. Furthermore, it would be desirable to provide a structural laminate with a high internal bond strength so that adhesive bridges are not needed. Additionally, it would be desirable to provide a laminate that is stronger and lighter than current aluminum products.

SUMMARY OF THE INVENTION

It is an objective of the invention to overcome one or more of the problems described above.

5 Accordingly, the invention provides a laminate formed of first and second metal skins with a resin-impregnated paper prepreg layer disposed between the metal skins. The resin content of the prepreg layer is an effective amount of less than about 40 wt.%.

10 Alternatively, the invention provides a laminate formed of first and second outer metal skins, a middle structural layer disposed between the metal skins, and at least two resin-impregnated paper prepreg layers, one layer disposed between the middle structural layer and each metal skin. The resin content of the prepreg layer is an effective amount of less than about 40 wt.%.

15 A method of preparing the structural laminate is also provided, including the steps of impregnating a paper with a resin to prepare a prepreg layer, partially drying the prepreg layer to partially cure the resin, disposing the prepreg layer between first and second metal skins to form a structural laminate, and applying sufficient pressure and heat to the laminate to fully cure the resin.

20 Further objectives and advantages of the invention may become apparent to those skilled in the art from a review of the following detailed description, taking in conjunction with the drawing figures and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a complete understanding of the invention reference should be made to the following detailed description and accompanying drawings wherein:

5 Figure 1 is a schematic view of a structural laminate according to a preferred embodiment of the invention;

Figure 2 is a schematic view of a structural laminate according to another embodiment of the invention; and,

10 Figure 3 is a schematic depiction of a manufacturing process employed to prepare a structural laminate of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The invention is directed to a structural laminate comprising first and second metal skins, each having a thickness of preferably at least about 15 5 mils, and more preferably in a range of about 7 mils to about 8 mils. For example, in one embodiment the metal skins can each have a thickness of about 7.5 mils, and in another embodiment the metal skins can each have a thickness of about 20 mils. The metal skins need not be the same thickness. Suitable metal skins include, but are not limited to, galvanized steel, standard steel, and 20 aluminum. A thermosetting resin-impregnated paper prepreg layer is disposed between the first and second metal skins. As used herein, reference to a prepreg layer includes, but is not limited to, at least one sheet of thermosetting resin-impregnated paper.

25 In another embodiment, the laminate is formed of first and second metal skins, a middle structural layer, and at least two prepreg layers, one layer disposed between the middle structural layer and each metal skin. The resin is present in the prepreg layer in an effective amount less than about

40 wt.%, preferably about 35 wt.%, based on the total weight of the prepreg layer. Suitable resins include, but are not limited to, thermosetting resins selected from the group consisting of epoxy resins, phenolic resins, polyester resins, vinyl ester resins, and combinations thereof.

5 A method of preparing the structural laminate is also provided, including the steps of impregnating a paper with a thermosetting resin to prepare a prepreg layer, partially drying the prepreg layer to partially cure the resin, disposing the prepreg layer between first and second metal skins to form a structural laminate, and applying sufficient pressure and heat to the laminate
10 to fully cure the resin.

 Referring to FIG. 1, the invention is directed to a structural laminate, generally designated 10, formed of first and second metal skins 20 and 22, respectively, each skin having a thickness of at least about 5 mils (e.g., a thickness of about 7 mils to about 8 mils), and a thermosetting resin-
15 impregnated paper prepreg layer 24 disposed between the first and second metal skins 20 and 22, respectively. The prepreg layer can be of any suitable overall thickness, for example about 10 mils to about 210 mils. The prepreg layer may be made of a plurality of paper sheets each having a thickness of about 10 mils to about 12 mils, for example.

20 The thermosetting resin-impregnated paper prepreg layer 24 illustratively includes two plies of 156 pound basis weight kraft paper obtained from Westvaco Corporation. The paper preferably is illustratively immersed in an epoxy resin to apply a resin content in an effective amount less than about 40 wt.% based on the total weight of the prepreg layer. Preferably, the resin
25 content is at least about 30 wt.%, more preferably in a range of about 32 wt.% to about 38 wt.%, and most preferably about 35 wt.%. Once the paper is immersed in the resin, the paper is dried in an oven at varied temperatures depending on the type of oven used. Preferably the paper is dried at temperatures ranging from about 200°F to about 365°F, and more preferably

about 315°F to about 365°F. The resin is only partially cured during this process, to help consolidate the laminate during the final press operation.

One epoxy resin that may be used to prepare the prepreg layer 24 is formed from bisphenol A-epichlorohydrin (a resin), dicyandiamide (a promoter), 2-methylimidazole (a catalyst), and methyl Cellosolve (a trademark of Union Carbide for an ethylene glycol monomethyl ether solvent). A preferred bisphenol A-epichlorohydrin based epoxy resin solution can be obtained from Shell under the tradename Epon®. Dicyandiamide is a commercial product name for cyanoguanidine that can be obtained from SKW Trostberg AG, Germany. 2-methylimidazole is a product name for 2-methyl-1H-imidazole that can be obtained from BASF Corporation in Parsippany, NJ.

The epoxy resin is preferably prepared by combining about 50 pounds of dicyandiamide, about 4000 grams of 2-methylimidazole, and about 650 pounds of methyl Cellosolve in a kettle. The mixture then is stirred under ambient conditions with a high speed sheer for about 20 minutes or until all of the dicyandiamide has dissolved. Next, about 1200 pounds of Epon® resin solution are added to the mixture and the resultant mixture is stirred under ambient conditions with a high speed sheer for about 20 minutes. Preferably the viscosity of the resulting epoxy resin, as measured by a Brookfield tester, is in a range of about 100 cps to about 300 cps, and more preferably about 150 cps to about 250 cps. Preferably the specific gravity is in a range of about 1.04 to about 1.07, and a stroke cure is between about 50 seconds and about 90 seconds.

Additionally, other thermosetting resins such as phenolic resins, polyester resins, and vinyl ester resins can be used to impregnate one or more kraft paper sheets forming a part of the prepreg layer. Generally, the resin content when using a phenolic resin may be reduced from that preferred for other, e.g., epoxy, resins. For example, the phenolic resin content is preferably at least about 25 wt.%, based on the total weight of the prepreg layer. If a phenolic resin is used to impregnate the kraft paper, a glue line or another

epoxy prepreg layer can be added adjacent to the metal skins to assist in bonding the metal skins to the prepreg layer(s). A phenolic resin-impregnated paper prepreg layer cannot be placed between the metal skins without an adhesive layer because it will not bond to the metal skins. Preferably, the resin may consist essentially of, or consist of, an epoxy resin because it provides improved moisture resistance, bond strength, and consolidation of the laminate.

The prepreg layer 24, once partially cured, is then prebuilt with the metal skins 20 and 22, respectively. The metal skins 20 and 22, respectively, preferably are formed of a metal selected from the group consisting of galvanized steel, standard steel, and aluminum. Preferably, galvanized steel skins are used, each having a thickness of at least about 5 mils. The resulting thickness of the laminate 10 can be varied by using different numbers of prepreg layers 24. The resulting total thickness of the laminate 10 can be up to about 2 inches, for example.

Preferably, the metal skins each have a thickness of about 7.5 mils, so that the resulting thickness of the laminate 10 will be about 35 mils. The prepreg layer 24 and metal skins 20 and 22 are then pressed at about 600 psi and heated to about 165°C for about 65 minutes to form the laminate 10. The laminate 10 is then cooled for about 30 minutes.

In a preferred embodiment to the structural laminate of the invention, the metal skins 20 and 22 each having a thickness of about 19 mils are disposed on either side of the prepreg layer 24 to form the laminate 10. The resulting thickness of the laminate 10 can be varied by using different numbers of prepreg layers 24. Preferably, the resulting thickness of the laminate 10 using metal skins 20 and 22 having thicknesses of about 19 mils will be about 250 mils.

Alternatively, as shown in FIG. 2, a middle structural layer 30 is disposed between the metal skins 26, and at least two thermosetting resin-impregnated paper prepreg layers 28 are disposed between the middle

structural layer 30 and the metal skins 26 to form the laminate 12. The middle structural layer 30 can be formed of a woven glass cloth, which would improve the impact and puncture resistance of the laminate 12. The resulting thickness of the laminate 12 can be varied by using different numbers of prepreg layers
5 28. Preferred thicknesses of the metal skins 26 and the middle structural layer 30 are described above.

Referring now to FIG. 3, a manufacturing process for the structural laminate will be described. An epoxy resin is obtained from a chemical source represented by an element 32 and then placed in a treating
10 apparatus 34. Rolls of kraft paper 36 are immersed in an epoxy resin bath, the resin content is metered using squeeze rolls 37, and then the paper is partially dried in one continuous process in an apparatus represented by element 38 to prepare prepreg layers 39. The prepreg layers 39 are then cut to a desired length at 40 and prebuilt at 42 with metal skins 43. The prepreg layers 39 and
15 metal skins 43 are subjected to pressure and heat as shown by a molding process 44. After the molding process 44 a structural laminate 46 is formed. The structural laminate 46 then undergoes shearing 48, inspection 50, and packaging 52. This manufacturing process is by way of illustration only and is not intended to be limited to only those manufacturing steps disclosed.

20 The resulting laminate of the invention has superior water resistance and good adhesion to the galvanized steel. A surprising result in the development is the good adhesion of the galvanized steel to the epoxy/paper prepreg in light of the inherent difficulty when laminating to a galvanized coating. Although both standard steel and aluminum could be used to form the
25 laminate, the laminate with the galvanized steel is stronger, lighter, and lower in cost.

The foregoing description is given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as modifications within the scope of the invention may be apparent
30 to those skilled in the art.

What is claimed is:

1. A structural laminate comprising:
 - (a) first and second metal skins, each skin having a thickness of at least about 5 mils; and
 - 5 (b) a thermosetting resin-impregnated paper prepreg layer disposed between the first and second metal skins, wherein the resin content of the prepreg layer is an effective amount less than about 40 wt.% based on the total weight of the prepreg layer.
- 10 2. The structural laminate of claim 1, wherein the resin is a thermosetting resin selected from the group consisting of epoxy resins, phenolic resins, polyester resins, vinyl ester resins, and combinations thereof.
- 15 3. The structural laminate of claim 1, wherein the resin comprises an epoxy resin.
- 20 4. The structural laminate of claim 3, wherein the prepreg layer further comprises at least one paper sheet impregnated with a phenolic resin.
5. The structural laminate of claim 1, wherein the resin comprises a dicy-epoxy resin.
- 25 6. The structural laminate of claim 1, wherein the resin consists essentially of an epoxy resin.
7. The structural laminate of claim 1, wherein the metal of the first and second metal skins is selected from the group consisting of galvanized steel, standard steel, and aluminum.

8. The structural laminate of claim 1, wherein the resin content of the prepreg layer is at least about 25 wt.%.

5 9. The structural laminate of claim 1, wherein the resin content of the prepreg layer is in a range of about 32 wt.% to about 38 wt.%.

10 10. The structural laminate of claim 1, wherein the resin content of the prepreg layer is about 35 wt.%.

11. The structural laminate of claim 1, wherein each of the first and second metal skins has a thickness of about 7.5 mils.

12. The structural laminate of claim 11, wherein the thickness of the structural laminate is about 35 mils.

13. The structural laminate of claim 1, wherein each of the first and second metal skins has a thickness of about 19 mils.

14. The structural laminate of claim 13, wherein the thickness of the structural laminate is about 250 mils.

15. The structural laminate of claim 1, wherein the thickness of the structural laminate is about 2 inches.

16. A method for preparing a structural laminate, the method comprising the steps of:

(a) impregnating paper with a thermosetting resin to prepare a prepreg layer, wherein the resin is present in an effective amount of less than about 40 wt.% based on the total weight of the prepreg layer;

(b) partially drying the prepreg layer to partially cure the resin;

(c) disposing the prepreg layer between first and second metal skins, wherein each skin has a thickness of at least about 5 mils, to form a laminate; and

(d) applying sufficient pressure and heat to the laminate to substantially fully cure the resin.

17. The method of claim 16, wherein the resin is a thermosetting resin selected from the group consisting of epoxy resins, phenolic resins, polyester resins, vinyl ester resins, and combinations thereof.

18. The method of claim 16, wherein the resin comprises an epoxy resin.

19. The method of claim 18, wherein the prepreg layer further comprises at least one paper sheet impregnated with a phenolic resin.

20. The method of claim 16, wherein the resin comprises a dicy-epoxy resin.

21. The method of claim 16, wherein the resin consists essentially of an epoxy resin.

22. The method of claim 16, wherein the metal of the first and second metal skins is selected from the group consisting of galvanized steel, standard steel, and aluminum.

23. The method of claim 16, wherein the resin content of the prepreg layer is at least about 25 wt.%.

5 24. The method of claim 16, wherein the resin content of the prepreg layer is in a range of about 32 wt.% to about 38 wt.%.

25. The method of claim 16, wherein the resin content of the prepreg layer is about 35 wt.%.

10 26. The method of claim 16, wherein the first and second metal skins each have a thickness of about 7.5 mils.

27. The structural laminate of claim 26, wherein the thickness of the structural laminate is about 35 mils.

15 28. The structural laminate of claim 16, wherein the first and second metal skins each have a thickness of about 19 mils.

20 29. The structural laminate of claim 28, wherein the thickness of the structural laminate is about 250 mils.

30. The structural laminate of claim 16, wherein the thickness of the structural laminate is about 2 inches.

31. A structural laminate comprising:

(a) first and second metal skins, each skin having a thickness of at least about 19 mils;

(b) a middle structural layer disposed between the first and second outer metal skins; and

(c) at least two thermosetting resin-impregnated paper prepreg layers disposed between the middle structural layer and each outer metal skin, wherein the resin content of the prepreg layer is an effective amount less than about 40 wt.% based on the total weight of the prepreg layer.

32. The structural laminate of claim 31, wherein the resin is a thermosetting resin selected from the group consisting of epoxy resins, phenolic resins, polyester resins, vinyl ester resins, and combinations thereof.

33. The structural laminate of claim 31, wherein the resin comprises an epoxy resin.

34. The structural laminate of claim 33, wherein the prepreg layer further comprises at least one paper sheet impregnated with a phenolic resin.

35. The structural laminate of claim 31, wherein the resin comprises a dicy-epoxy resin.

36. The structural laminate of claim 31, wherein the resin consists essentially of an epoxy resin.

37. The structural laminate of claim 31, wherein the metal of the first and second metal skins is selected from the group consisting of galvanized steel, standard steel, and aluminum.

38. The structural laminate of claim 31, wherein the middle structural layer is a woven glass cloth.

5 39. The structural laminate of claim 31, wherein the resin content of the prepreg layer is at least about 25 wt.%.

40. The structural laminate of claim 31, wherein the resin content of the prepreg layer is in a range of about 32 wt.% to about 38 wt.%.

10 41. The structural laminate of claim 31, wherein the resin content of the prepreg layer is about 35 wt.%.

42. The structural laminate of claim 31, wherein the thickness of the structural laminate is about 250 mils.

15 43. The structural laminate of claim 31, wherein the thickness of the structural laminate is about 2 inches.

1 / 2

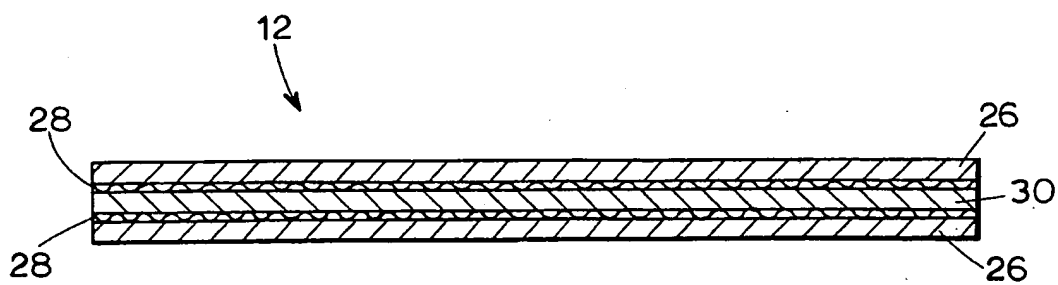


FIG. 2

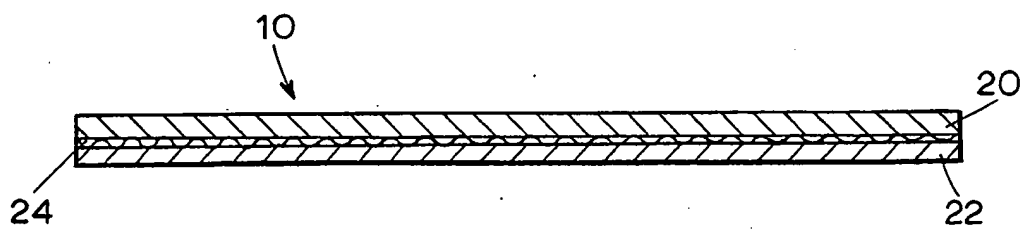
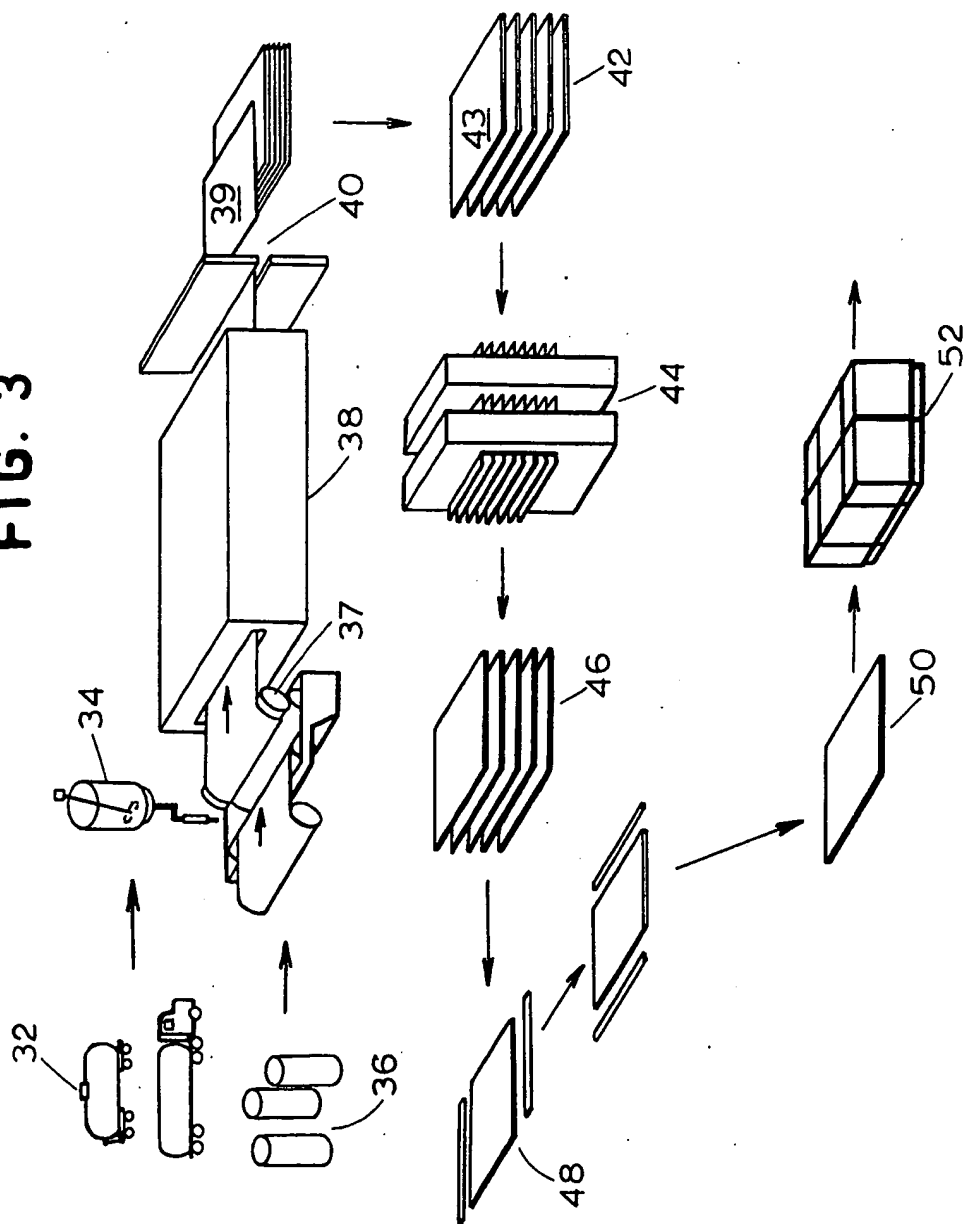


FIG. 1

2 / 2

FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/03681

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B15/12 B32B29/06 E04C2/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B32B E04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 35114 A (CLIFFORD DAVID D ARCY ;DOFASCO INC (CA)) 13 August 1998 (1998-08-13) cited in the application claims; table 2 ---	1-30
A	FR 1 579 770 A (REICHHOLD-BECKACITE) 29 August 1969 (1969-08-29) page 1, line 35 -page 2, line 1; claims page 2, line 29 - line 40 ---	1-30
A	GB 2 148 793 A (SANYO KOKUSAKU PULP CO) 5 June 1985 (1985-06-05) page 2, line 19 - line 34; claims -----	1-30

☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search

25 October 1999

Date of mailing of the international search report

04/11/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Pamies Olle, S

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/03681

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9835114 A	13-08-1998	AU 6816498 A	26-08-1998
		CA 2248603 A	13-08-1998
FR 1579770 A	29-08-1969	CH 502896 A	15-02-1971
		GB 1225500 A	17-03-1971
GB 2148793 A	05-06-1985	JP 1036851 B	02-08-1989
		JP 60079952 A	07-05-1985
		DE 3436665 A	09-05-1985
		FR 2553030 A	12-04-1985
		US 4652324 A	24-03-1987